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Arizona's Legacy and Leadership in Wastewater Reuse

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Scottsdale, Arizona
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Arizona's Reuse Program

- Where we've been
- What are we doing now?
- Where are we headed?

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Reclaimed Water Use in Arizona

- 90% of reuse occurs in just four states, Arizona being one

Why Arizona?

- Driven by need
- Comprehensive legal framework

Source: Western Water, July/August 2008

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Driven by Need

Arizona was one of the first states to reuse treated wastewater

- Grand Canyon Village – 1926

- 1st WWTP in US built specifically to allow reuse (0.13 mgd capacity)
  - Toilet flushing
  - Boiler feed for power generation
  - Water for steam locomotives

The Next Reuse Milestone

- 1931 – Phoenix 23rd Avenue WWTP constructed

  - 15 mgd capacity

  - secondary treatment

  - chlorine disinfection of effluent

Arizona Sewage Works Association members at Phoenix plant, 1937

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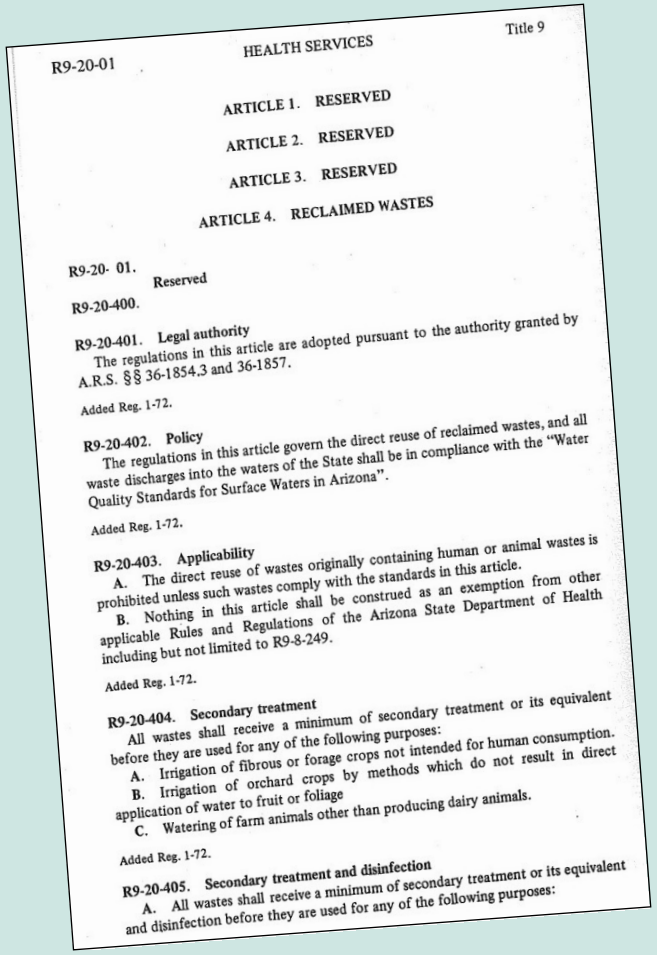
The Next Reuse Milestone

- 1932 – reuse for irrigated agriculture begins using reclaimed water from Phoenix 23rd Avenue WWTP

- Phoenix WWTPs distribute reclaimed water for irrigated agriculture to this day

Ahead of the Times

- Jan 1972 – Arizona's 1st reclaimed water rules, ADHS
- 3 water quality designations
  - Secondary
  - Secondary w/disinfection
  - Tertiary w/disinfection



R9-20-01 HEALTH SERVICES Title 9

ARTICLE 1. RESERVED

ARTICLE 2. RESERVED

ARTICLE 3. RESERVED

ARTICLE 4. RECLAIMED WASTES

R9-20- 01. Reserved

R9-20-400.

R9-20-401. Legal authority
The regulations in this article are adopted pursuant to the authority granted by A.R.S. §§ 36-1854.3 and 36-1857.

Added Reg. 1-72.

R9-20-402. Policy
The regulations in this article govern the direct reuse of reclaimed wastes, and all waste discharges into the waters of the State shall be in compliance with the "Water Quality Standards for Surface Waters in Arizona".

Added Reg. 1-72.

R9-20-403. Applicability
A. The direct reuse of wastes originally containing human or animal wastes is prohibited unless such wastes comply with the standards in this article.
B. Nothing in this article shall be construed as an exemption from other applicable Rules and Regulations of the Arizona State Department of Health including but not limited to R9-8-249.

Added Reg. 1-72.

R9-20-404. Secondary treatment
All wastes shall receive a minimum of secondary treatment or its equivalent before they are used for any of the following purposes:
A. Irrigation of fibrous or forage crops not intended for human consumption.
B. Irrigation of orchard crops by methods which do not result in direct application of water to fruit or foliage
C. Watering of farm animals other than producing dairy animals.

Added Reg. 1-72.

R9-20-405. Secondary treatment and disinfection
A. All wastes shall receive a minimum of secondary treatment or its equivalent and disinfection before they are used for any of the following purposes:

Reclaimed water reuse begins at Fountain Hills, 1974

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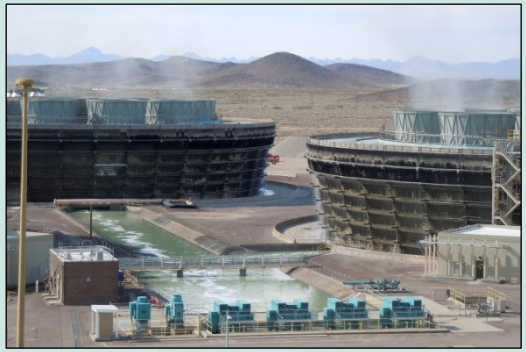
Reclaimed Water for Power Generation

- 1983 – Phx 91st Ave WWTP delivers treated wastewater to Palo Verde NGS
- Largest nuclear power plant in US
- Unique in world: 100%-cooled by reclaimed water
- 36 mi. long pipeline, 6.5–9.5' diameter
- Delivers ~60 mgd (45% of WWTP flow)

Phoenix 91st Ave WWTP



APS PVNGS water treatment plant
Credit: Cronkite News

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Reclaimed Water for Recharge

- 1989 – Tucson Sweetwater Recharge Facility
- First full-scale engineered recharge project in AZ utilizing reclaimed water
- Recharges 5.8 mgd under permits from ADEQ & ADWR

Credit: City of Tucson

Comprehensive Regulatory Framework

- 1999 – ADEQ gets clear legislative authority for permitting use of reclaimed water

- 2001 - New rules transformed program
  - Foster reuse while protecting WQ & human health
  - Three part approach
    - Aquifer Protection Permit
    - Reclaimed Water Permit
    - Reclaimed Water Quality Standards

Credit: Verde News

Arizona's Regulatory Framework

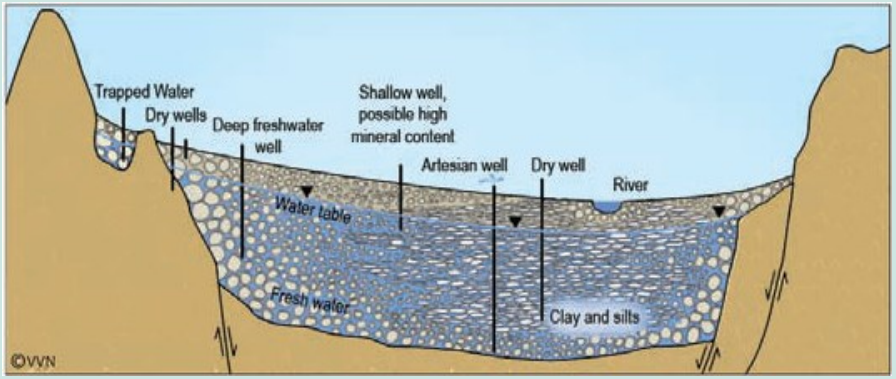
- **Aquifer Protection Permit (APP)**
  - WWTP responsible for reclaimed water quality
- **Reclaimed Water Permit (RWP)**
  - regulates use & application by end user
- **Reclaimed Water Quality Stds (RWQS)**
  - 5 classes of reclaimed water:

A+ A B+ B C

Aquifer Protection Permit Program

- Unique AZ permit that protects groundwater for "drinking water protected use"

PVNGS



ASARCO Ray Mine

- ADEQ issues APPs to mines, industrial facilities, WWTPs, etc., to control discharges to groundwater

The Two Pillars of APP Protection

1. Discharge must not exceed any Aquifer Water Quality Standard (i.e., MCL) at a point of compliance (POC) in the aquifer

   - *POC set in aquifer at limit where pollutants are placed (e.g., dike, impoundment, etc.)*
   - *No further degradation if AWQS already exceeded*

Palo Verde Nuclear Generating Station

The Two Pillars of APP Protection

2. Facility also must employ Best Available Demonstrated Control Technology (BADCT)
   - Example: BADCT for new or expanding WWTPs
     - EPA Secondary Standards
     - Pathogen-free effluent
     - Nitrogen removal
     - Odor control

Newly upgraded Nogales International Wastewater Treatment Plant

Five Reclaimed Water Quality Classes

- Class A+, A: *open access* uses
  - pathogen-free
  - turbidity <2 NTU
  - denitrified (A+)
- Class B+, B: *restricted access* uses
  - fecal coliform organisms less than 200/100 ml
  - denitrified (B+)
- Class C: very limited uses
  - fecal coliform <1000/ml
- To gain the +, nitrogen must be removed to below 10 mg/l

Turf irrigation at NAU with Class A+ water

Class A, A+ Reclaimed Water

- *Open access* uses – access by general public is uncontrolled
- Some of the uses allowed in rule
  - irrigation of food crops
  - recreational impoundments
  - residential/schoolyard irrigation
  - toilet & urinal flushing
  - fire protection systems
  - snowmaking

Reclaimed Water Fire Hydrant

Freestone Park, Gilbert

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But… Some Prohibitions

- Evaporative cooling or misting
- Full-immersion water activities w/potential for ingestion (swimming, windsurfing, water skiing, etc.)
- ***Direct reuse for human consumption***

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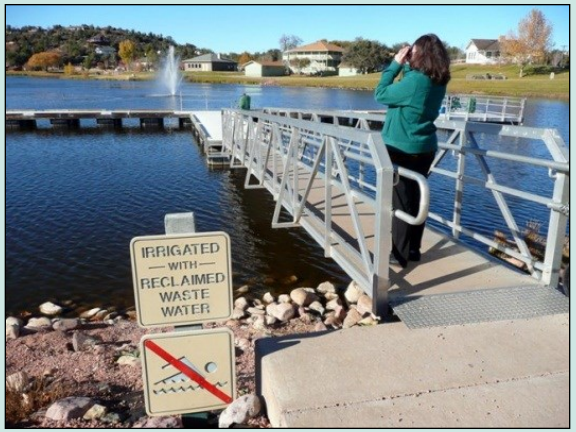
Arizona's Successful Reclaimed Program

- 60% of all 300 WWTPs in AZ (~180) now distribute treated wastewater for reuse
- Of the 98 largest plants, 93 distribute for reuse

Pumping reclaimed water, Surprise, Arizona

Reclaimed Water Amenity, Sun Lakes, Maricopa County



Town of Payson Green Valley Lake

How Good is the Reclaimed Water?

Of the 98 Largest Plants:

- 57% produce Class A+ water
- Recent good news: The 3rd and 4th largest plants in AZ (in Tucson) were upgraded to Class A+

Flagstall Wildcat Hill WWTP

Upgrading the Ina Road WWTP to A+, Tucson
Credit: Tucson Citizen

Where Does the Flow Go?

98 WWTPs With Design Flow ≥ 1 mgd*

REUSE

"Disposal" Method	No. of WWTPs	Percent	Sole Method
REUSE	91	93%	18

*Equal to about 700 gpm or 1.5 cfs

Where Does the Flow Go?

98 WWTPs With Design Flow ≥ 1 mgd

GROUNDWATER RECHARGE

"Disposal" Method	No. of WWTPs	Percent	Sole Method
RECHARGE*	53	54%	4

*Includes constructed recharge projects for credits & RIBs for disposal

Where Does the Flow Go?

98 WWTPs With Design Flow ≥ 1 mgd*

TO THE ENVIRONMENT

"Disposal" Method	No. of WWTPs	Percent	Sole Method
SURFACE WATER	45	46%	2*

*Nogales International & Yuma Figueroa Street WWTPs

Reuse vs. "Disposal" (Phoenix)

- Disposition of treated wastewater (by volume)

- Power	22%
- Agriculture	22%
- Recharge	21%
- Environmental (i.e., Tres Rios)	11%
- Landscape, turf irrigation	6%
REUSED	82%
- Discharged (uncommitted)	18%
TOTAL	100%

Source: "Water Reuse in Central Arizona," ASU Decision Center for a Desert City, 2013

Reclaimed Water Permits

- 400 end user permits issued to individuals (e.g., farmers) and large distribution systems

  - 72% are for Class A+ reclaimed water

Reclaimed water pumps, Flagstaff, Arizona

Reclaimed Water Systems

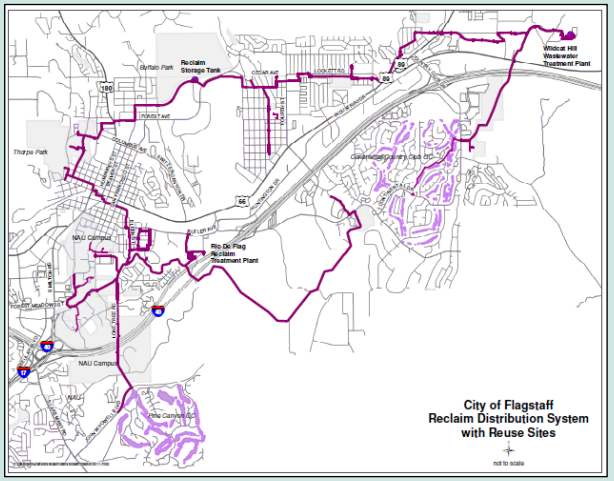
- 47 permits issued for large systems
- 1000s of residential, M & I, and agricultural users are served
- Arizona's largest system (based on no. of end users)

  - City of Tucson
    - 160 miles of purple pipe
    - 18 golf courses
    - 39 parks
    - 52 schools (incl. University of Arizona)
    - more than 700 single family homes

Irrigating athletic field with reclaimed water, University of Arizona

Reclaimed Water Agent Permits

- **Flagstaff – another big system**
  - 13 schools (incl. NAU)
  - 18 parks & other landscaped sites
  - 4 golf courses
  - 2 cemeteries
  - 1 ski area
  - 1 industry: SCA Tissues



"De Facto" Potable Reuse

- 1-2% of CAP Canal water to Phx/Tucson derives from upstream treated wastewater (Las Vegas)
  - modeling & sucralose tracer analysis from L. Havasu & downstream points in CAP Canal by Dr. Paul Westerhoff, ASU
- L. Havasu could contain as much as 14% wastewater during low-flow drought conditions per modeling

Treated wastewater in Las Vegas Wash flowing to L. Mead (SNWA photo)

CAP Canal at intake to Mesa Water Treatment Plant (U of A photo)

"De Facto" Potable Reuse

- ADWR issues permits for recharge facilities
  - Permittees get recharge credits to offset groundwater pumpage
- 55 constructed groundwater recharge facilities are permitted by ADWR to use reclaimed water ("effluent")
  - 5 are mixed source (CAP, SW, Reclaimed)
  - 50 use reclaimed water only
- Permitted flow to the 50 is 169,000 af/yr (151 mgd)
  - compare with permitted design flow of all WWTPs: 885 mgd

Town of Prescott Valley Recharge Facility (Civiltech Engineering photo)

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Perception

What do we call it?

Effluent – ADWR terminology in statute & rule

- not quite "toilet-to-tap", but…

Reclaimed water – ADEQ terminology in statute & rule

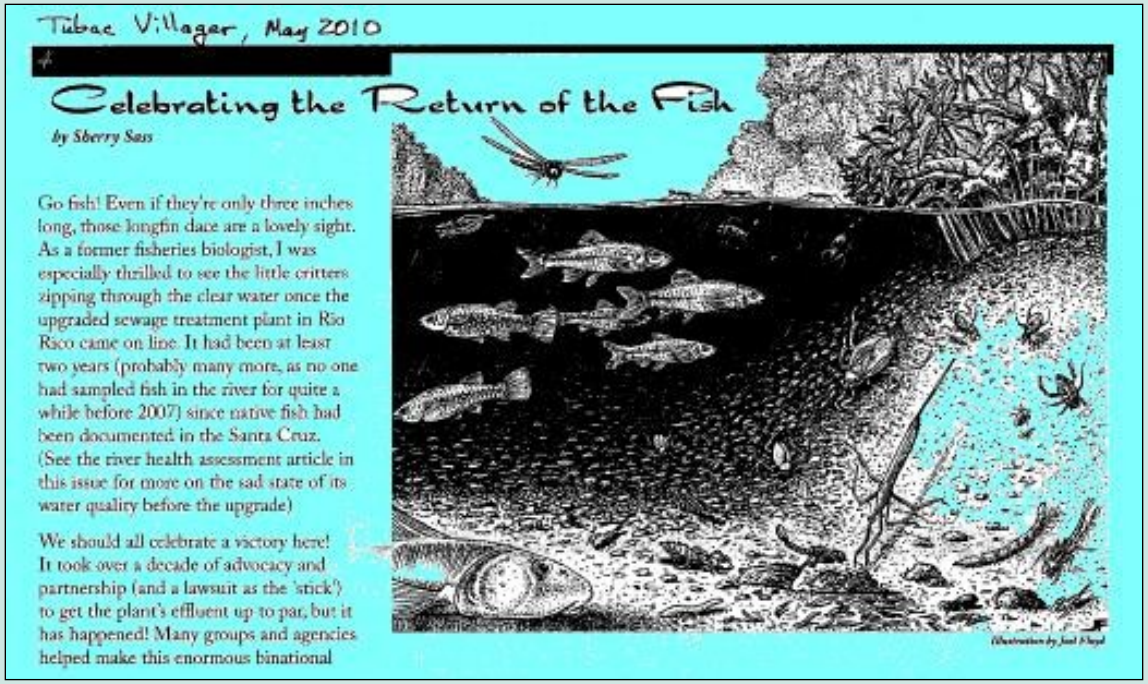
Recycled water – California Title 22 regulations

What's your opinion?

New Water **- Singapore terminology for highly-treated wastewater prepared for drinking**

Program Successes

- New & expanding WWTPs eliminate new N-contaminated groundwater sites due to discharges
- Many formerly poor-quality discharges have been dramatically improved
  - Nutrients
  - Clarity
  - Health risk



Tubac Villager, May 2010

Celebrating the Return of the Fish

by Sherry Sass

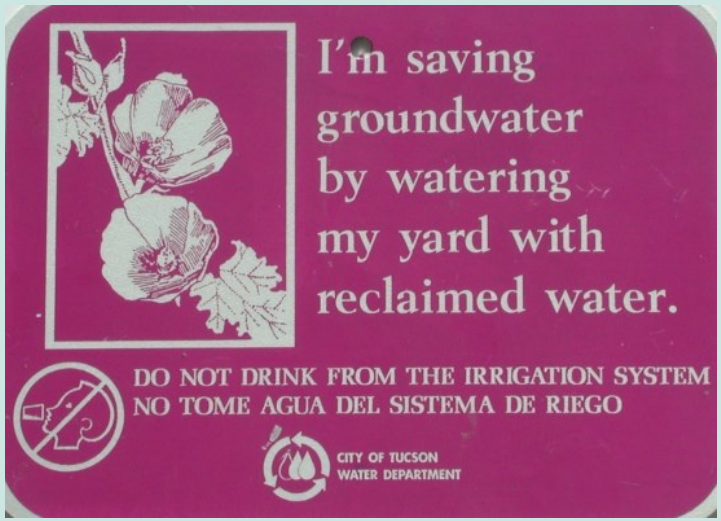
Go fish! Even if they're only three inches long, those longfin dace are a lovely sight. As a former fisheries biologist, I was especially thrilled to see the little critters zipping through the clear water once the upgraded sewage treatment plant in Rio Rico came on line. It had been at least two years (probably many more, as no one had sampled fish in the river for quite a while before 2007) since native fish had been documented in the Santa Cruz. (See the river health assessment article in this issue for more on the sad state of its water quality before the upgrade)

We should all celebrate a victory here! It took over a decade of advocacy and partnership (and a lawsuit as the 'stick') to get the plant's effluent up to par, but it has happened! Many groups and agencies helped make this enormous binational

Santa Cruz River below the upgraded Nogales International WWTP comes back to life

Program Successes

- Large majority of WWTPs now produce high-quality treated wastewater suitable for reuse
  - Has turned a waste “to be gotten rid of” into a resource with value



Wheeling reclaimed water around, Gilbert Riparian Preserve

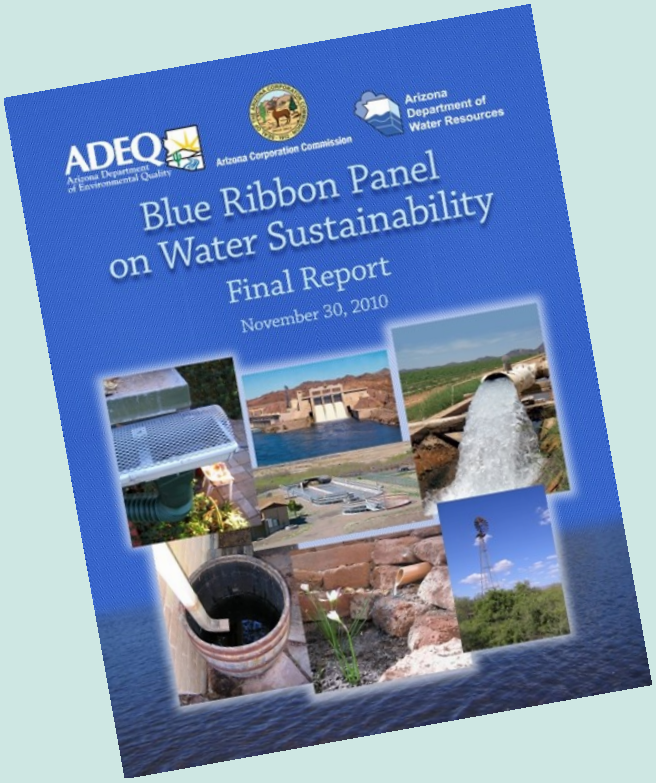
More Good News— Emerging Contaminants

- Unlike most states, AZ mandates high-performance treatment w/N-removal in all new & expanding WWTPs
- Corollary benefit: Much greater CEC removal
- Work by UA & others shows high CEC removal rates
  - Traditional treatment : 20-40%
  - Tertiary treatment with N-removal: 60-99+%

Raw sewage/
Aeration basin/
Tertiary-treated water

Governor's Blue Ribbon Panel on Water Sustainability

- Met throughout 2010
- Issued Final Report Nov. 2010
- ***"current programs constitute an exceptional framework..."***
- But ... some key reclaimed water recommendations in report



1. Emerging Contaminants

- Convene stakeholders group to address ECs in reclaimed & other waters
- Advisory Panel on Emerging Contaminants (APEC)
  - convened by ADEQ in Jan 2013 with 35 experts
- Will provide guidance to agencies & utilities on unregulated EC issues
- Report expected in early-2015

Reclaimed water used for snowmaking, Arizona Snowbowl, Flagstaff

2. Potable Reuse

- Establish steering group to determine technologies, criteria, and administrative changes that will advance potable reuse
  - Steering Committee on Arizona Potable Reuse (SCAPR) taking the lead

Scottsdale Water Campus
Credit: Ludvik Electric

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Trends in Reuse: SCAPR Concerns

- Non-potable reuse—reclaimed water delivered through a distribution system wholly separate from the potable system

↓

- Indirect potable reuse (IPR)—recharging reclaimed water into the aquifer or augmenting a surface water supply

↓

- Direct potable reuse (DPR)—introducing reclaimed water into a potable system

Holding reclaimed water for reuse, Lake Havasu City, AZ (Lake Havasu City photo)

Future Reuse Trends?

- Transition to higher-valued reclaimed water end uses
- Increased utilization, particularly off-season use
- Increased reuse at smaller plants & in smaller communities

Future Reuse Trends?

- More multi-purpose & community enrichment projects

Kino Environmental Restoration Project
Credit: Pima County

Town of Payson
Green Valley Lake

Anthem Community Park
Credit: MCM Group

Birdwatching blind,
Veterans Oasis Park, Chandler
Credit: Buck-Fever

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Questions?

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